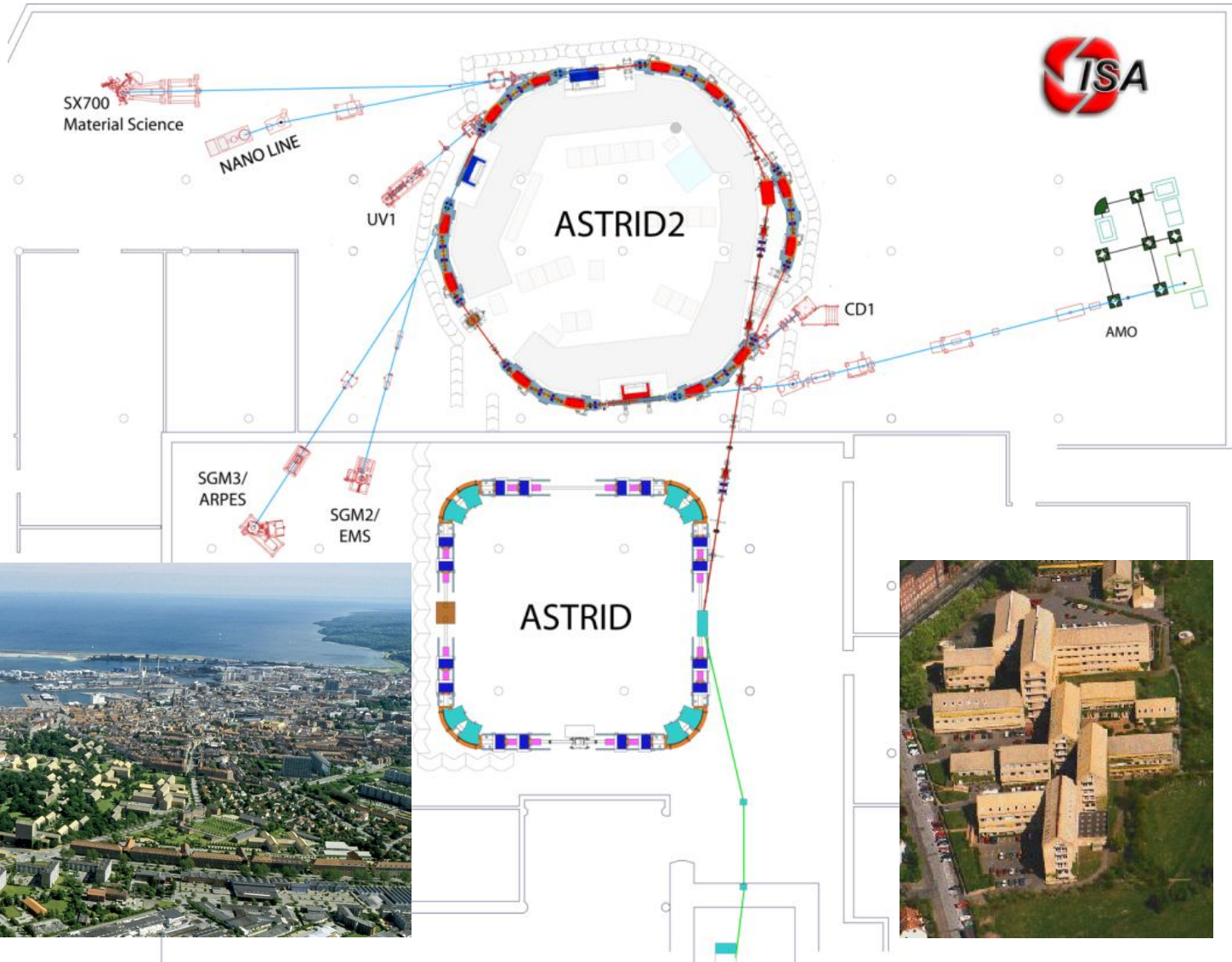


CONSYS UPDATE & A LABVIEW FPGA BASED RF SYSTEM

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ASTRID/ASTRID2 OVERVIEW



ASTRID AND ASTRID2

	ASTRID	ASTRID2
Energy	580MeV	580MeV
Design current	200mA	200mA
Injection	From 100 MeV microtron once a day	580MeV from ASTRID Top-up every 3-4 minutes.
Emittance	140nm	10nm
Free straight sections	1 (2)	4



CONSYS – THE CONTROL SYSTEM

- › Control System for
 - › University of Aarhus: ASTRID, ASTRID2, ELISA and several smaller machines
 - › Stockholm University: CRYRING, DESIREE
- › Mature system, running since 1998
- › Standard model, publisher/subscriber
- › Running on Windows
- › Microsoft C++, object oriented based on MFC classes
- › Same core system on all computers
- › Configurable – Stored in SQL database
 - › Address device and parameter location
 - › Conversion information for scaling etc.
 - › Display information

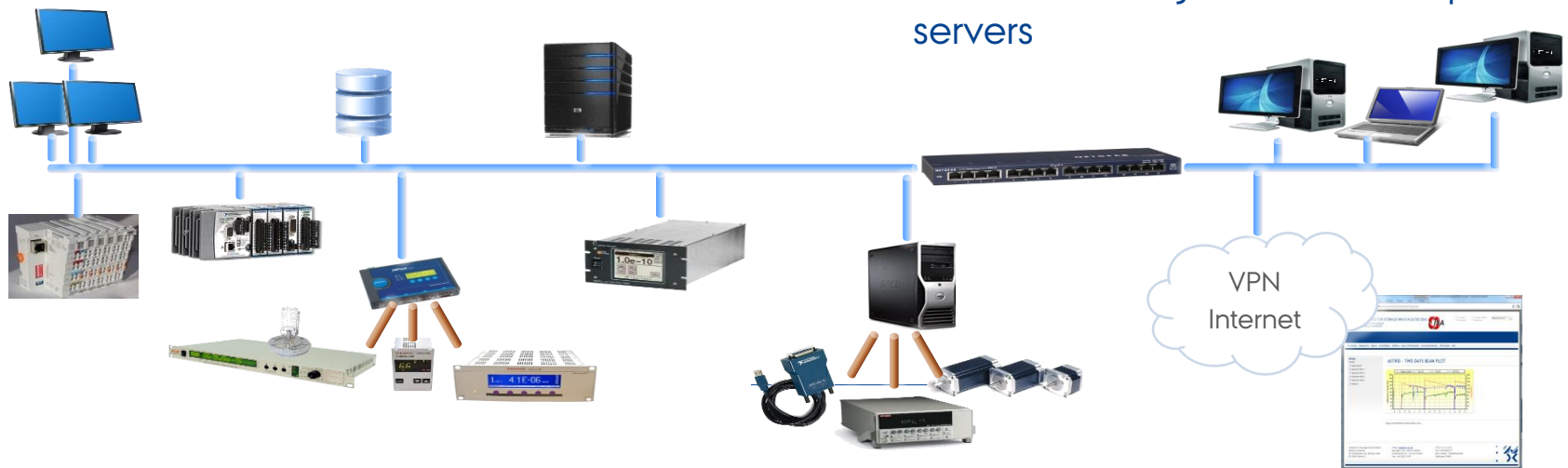
CONSYS DEVICES

> Old systems

- > Generic I/O
 - > G64
- > Dedicated hardware
 - > Serial and GPIB, connected directly to device computer.

> New systems: Ethernet

- > Generic I/O
 - > PLC's
 - > NI Shared variables
 - > EPICS channels
- > Dedicated hardware
 - > Preferable Ethernet
 - > Serial Communication
 - > Serviced through MOXA serial port servers



CONSYS PARAMETERS

> Basic parameter types:

- > BOOLEAN, WORD, FLOATING POINT, TIME, STRING

> Complex parameter types:

- > Any structure can be a parameter

> Clusters

- > Parameters are grouped into clusters
- > Typical relates to a specific piece of hardware
- > No binding on the source of the parameter, can be from several different devices/locations

> Naming

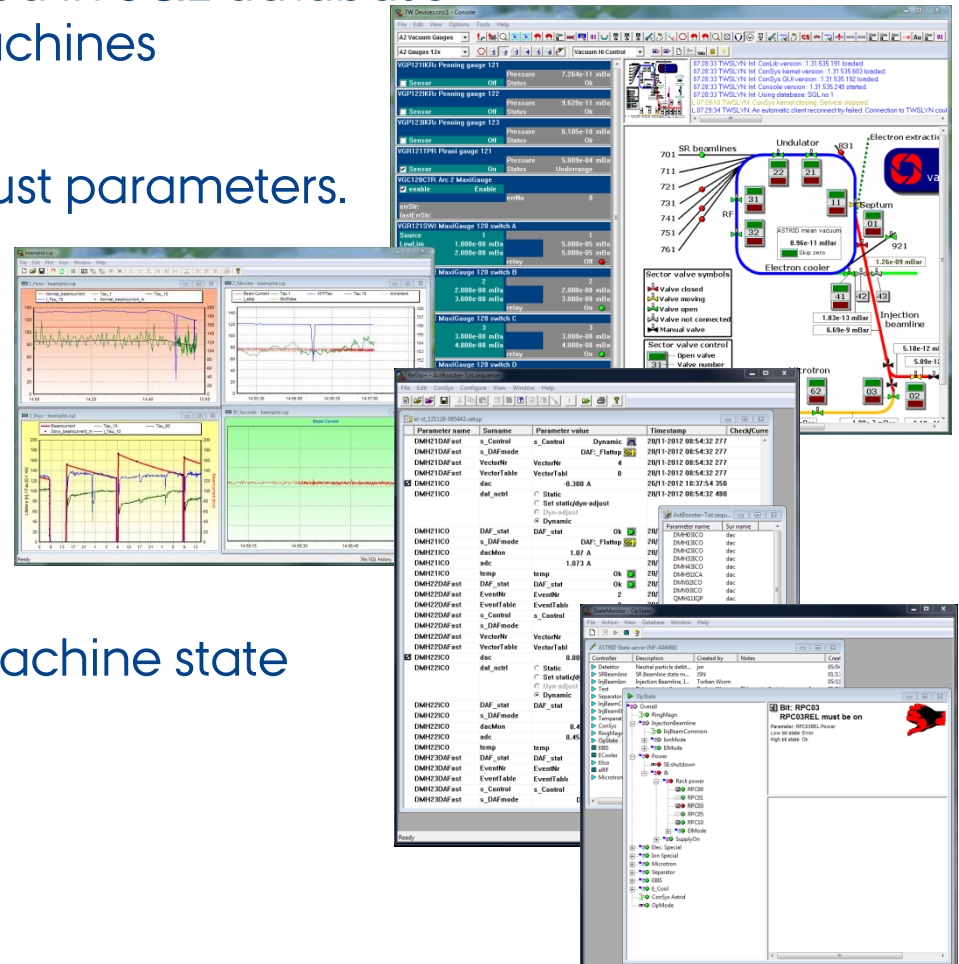
- > <Cluster name>.<sur name>, ex. BMH100IPSast2.lw

AUTOMATION

- › Strong support for automation
 - › Any ConSys device can access any ConSys parameter
 - › Used in automation devices
- › Examples
 - › Electron operation:
 - › The steps involved in injections are heavily automated
 - › Copying of different settings for store and accumulations
 - › Automatic RF power control
 - › ...
 - › Calculation of power & resistance from current & voltage
 - › Simultaneous control of several parameters
 - › Averaging

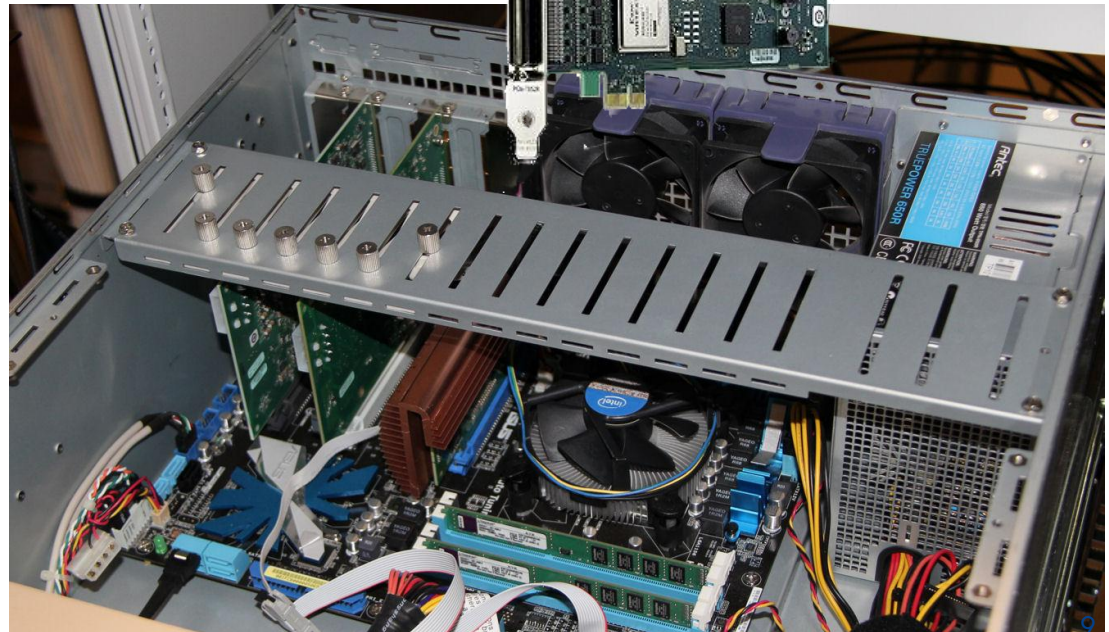
GENERAL APPLICATIONS

- › Machine independent applications
 - › Configurable, configurations stored in SQL database
 - › Same applications used at all machines
- › Console
 - › Main program to display and adjust parameters.
- › CSPlot
- › Datalogger
- › ReSto
- › RampControl
- › StateMonitor
 - › Condition based monitoring of machine state
- › FileLogger
- › MassScan



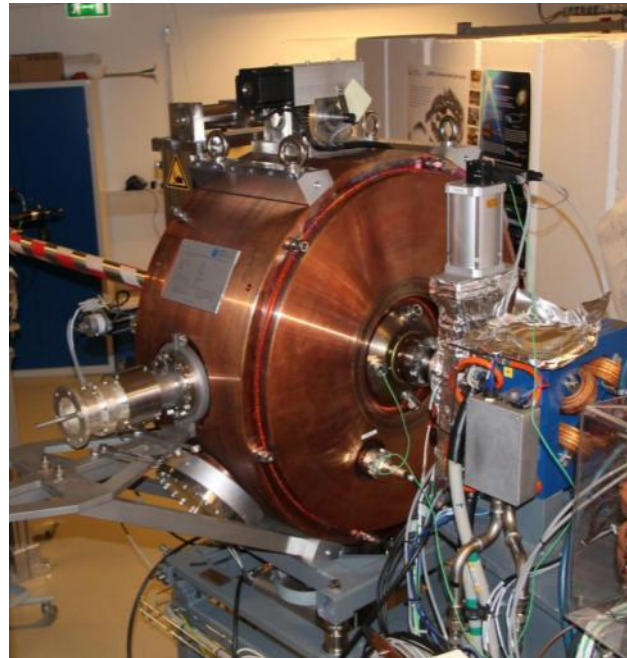
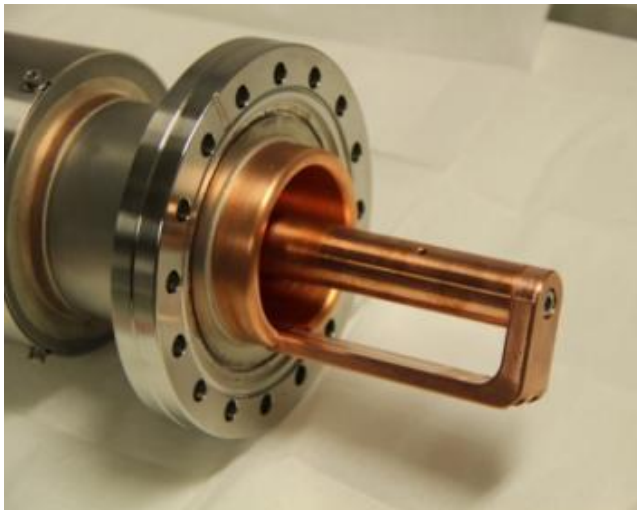
NEW ASTRIDx LLRF

- > Since January 2011: New LLRF in operation at ASTRID
- > Has been working without any problems
- > Same system used for ASTRID2 (except for different tuning control)
- > Rack PC:
 - > LabVIEW Real-Time
 - > FPGA equipped multifunction card
- > NI PCIe-7852R:
 - > Virtex 5 FPGA, 8 AI, 750 kS/s/ch, 8 AO, 1 MS/s/ch, 16 bit
- > PCIe-6323
 - > 16 AI, 250 kS/s/ch, 4 AO, 16 bit



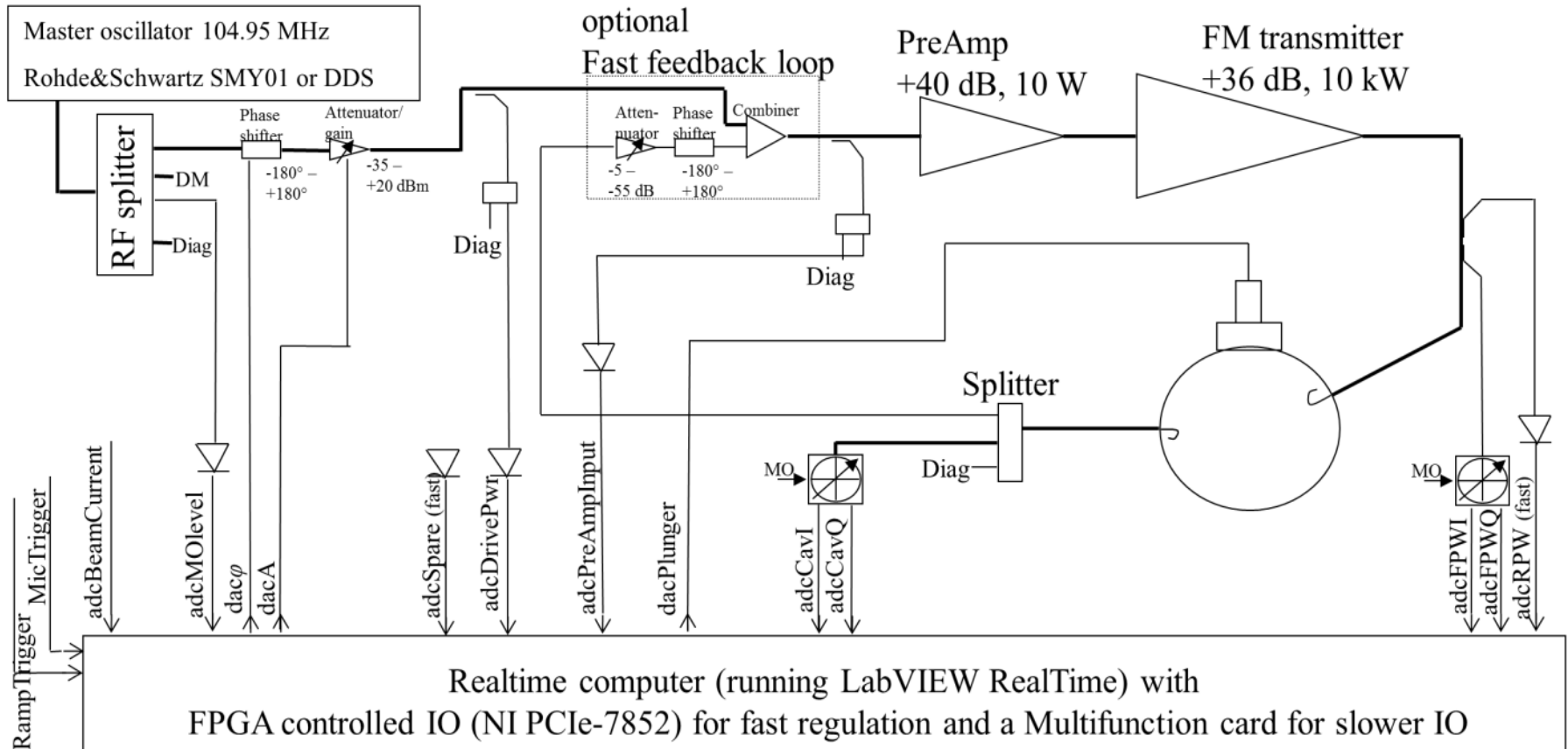
RF CAVITY

- › The 105 MHz cavity (modified MAX IV design) was made by Research Instruments.
- › The transmitter is a 8kW solid state unit from Tomco (Australia).



RF SYSTEM – DESIGN LAYOUT

- > Digital control of baseband signal
- > Detection: IQ demodulators with low pass filter
- > ± 180 phase detection
- > Control: Amplitude and Phase (voltage controlled)



RF SYSTEM SOFTWARE

> FPGA

- > 500 kHz sampling rate
- > Calculate Amplitude & Phase from IQ
- > Low pass filter
- > Amplitude loop, bandwidth ~ 50 kHz
- > DMA: Measured & Calculated values

> Real-Time

- > Cavity tuning loop
- > Phase Loop
- > History buffer
- > Generation of live plots
- > User interface through shared variables

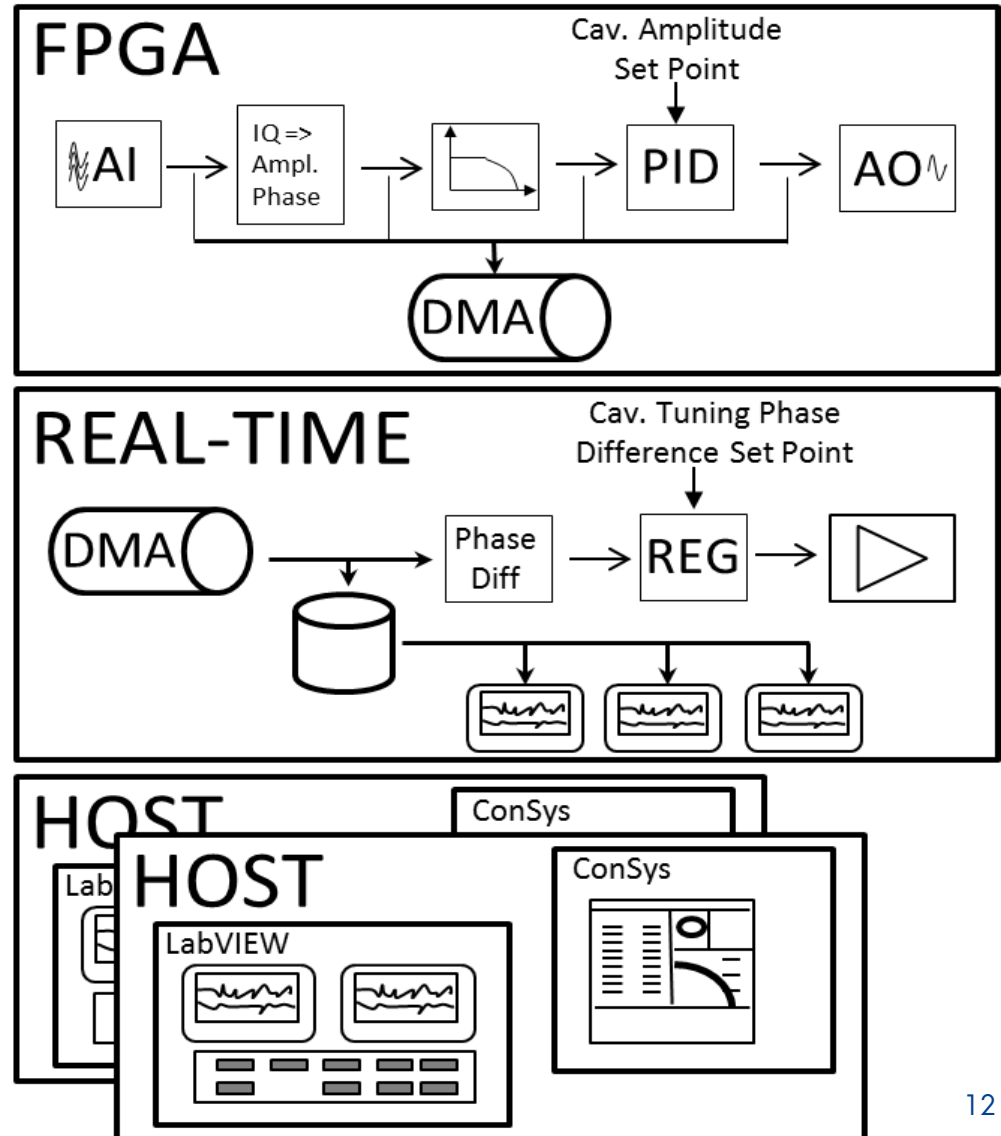
> Host

- > LabVIEW operator display
- > Display live plots generated by RT
- > Control & Status through RT shared variables

> ConSys

- > Control & Status through RT shared variables

> All levels: LabVIEW 2012



CONSOLE

- > Main program to display and adjust parameters.
- > Machine independent
 - > Console pages defined in database
- > 'Analogue' control
 - > Control bars with 'analogue' control of two parameters.
 - > Mouse control
 - > Digital potentiometers
- > Graphics pages based on drawings with overlaid controls.



The screenshot shows the 'Default.cns - Console' window. On the left, a list of PFW Q-pole verticals is displayed, each with its own control panel. The right side features a vacuum system schematic with various valves and pressure gauges. A legend for sector valve symbols and controls is provided below the schematic.

Vertical ID	Current (A)	Write Mean (A)	Read Mean (A)	Ir (V)	Ur (V)	SumFail	Status
QPV111PSa PFW Q-pole vertical 111	-3.00	-3.00	-0.11	-0.11	-0.17	Ok	Green
QPV112PSa PFW Q-pole vertical 112	-3.00	-3.00	-0.10	-0.10	-0.17	Ok	Green
QPV121PSa PFW Q-pole vertical 121	-3.00	-3.00	-0.11	-0.11	-0.17	Ok	Green
QPV122PSa PFW Q-pole vertical 122	-3.00	-3.00	-0.10	-0.10	-0.17	Ok	Green
QPV131PSa PFW Q-pole vertical 131	-3.00	-3.00	-0.11	-0.11	-0.17	Ok	Green
QPV132PSa PFW Q-pole vertical 132	-3.00	-3.00	-0.11	-0.11	-0.17	Ok	Green
QPV141PSa PFW Q-pole vertical 141	-3.00	-3.00	-0.10	-0.10	-0.17	Ok	Green
QPV142PSa PFW Q-pole vertical 142	-3.00	-3.00	-0.11	-0.11	-0.17	Ok	Green
QPV151PSa PFW Q-pole vertical 151	-3.00	-3.00	-0.09	-0.09	-0.17	Ok	Green
QPV152PSa PFW Q-pole vertical 152	-3.00	-3.00	-0.14	-0.14	-0.17	Ok	Green

The vacuum system schematic shows various components including SR beamlines, Undulator, Electron cooler, Microtron, and several valves (e.g., 01, 11, 21, 31, 32, 41, 42, 43, 61, 62, 03). Pressures are indicated at various points, such as 8.76e-11 mBar for the ASTRID mean vacuum and 6.17e-10 mBar for the Microtron. A legend defines valve symbols: Valve closed (red), Valve moving (yellow), Valve open (green), Valve not connected (grey), and Manual valve (black). Sector valve controls are shown as green boxes with 'Open valve', 'Valve number', and 'Close valve' indicators.

STATEMONITOR

- › Machine State Monitoring
 - › Condition based
 - › Tree structure
 - › Leaves:
 - › Parameter based conditions
 - › Constants
- › Tree structure
 - › Logical operations
 - › Timed override
 - › SMS alarms
 - › E-mail alarms

The screenshot displays the StateMonitor - OpState application. At the top, there is a menu bar with 'File', 'Action', 'View', 'Database', 'Window', and 'Help'. Below the menu is a toolbar with icons for file operations and execution. The main area is divided into several panes:

- ASTRID State server (NF-A04068):** A table listing controllers and their descriptions.

Controller	Description	Created by	Notes	Created
Detektor	Neutral particle detkt...	jsn		05/04
SRBeamline	SR Beamline state m...	JSN		01/17
InjBeamlon	Injection Beamline, L...	Torben Worm		05/11
- Tree Structure:** A hierarchical view of the system components. The 'OpState' folder is expanded, showing sub-folders like 'Overall', 'RingMagn', 'InjectionBeamline', 'IonMode', 'EIMode', 'Power', 'SE:shutdown', 'Rack power', 'SupplyOn', 'Elec. Special', 'Ion Special', 'Microtron', 'Separator', 'EBIS', 'E_Cool', 'ConSys Astrid', and 'OpMode'. Each component is represented by a small icon.
- Bit Detail Panel:** A window titled 'Bit: RPC03' showing the status of a specific bit. It displays the text 'RPC03REL must be on' in red. Below this, it shows the parameter 'RPC03REL.Power' and its state: 'Low bit state: Error' and 'High bit state: Ok'. A red hand icon is visible in the top right corner of this panel.

RESTO

> Store

- > All values (in groups)
- > Read/Write

> Restore

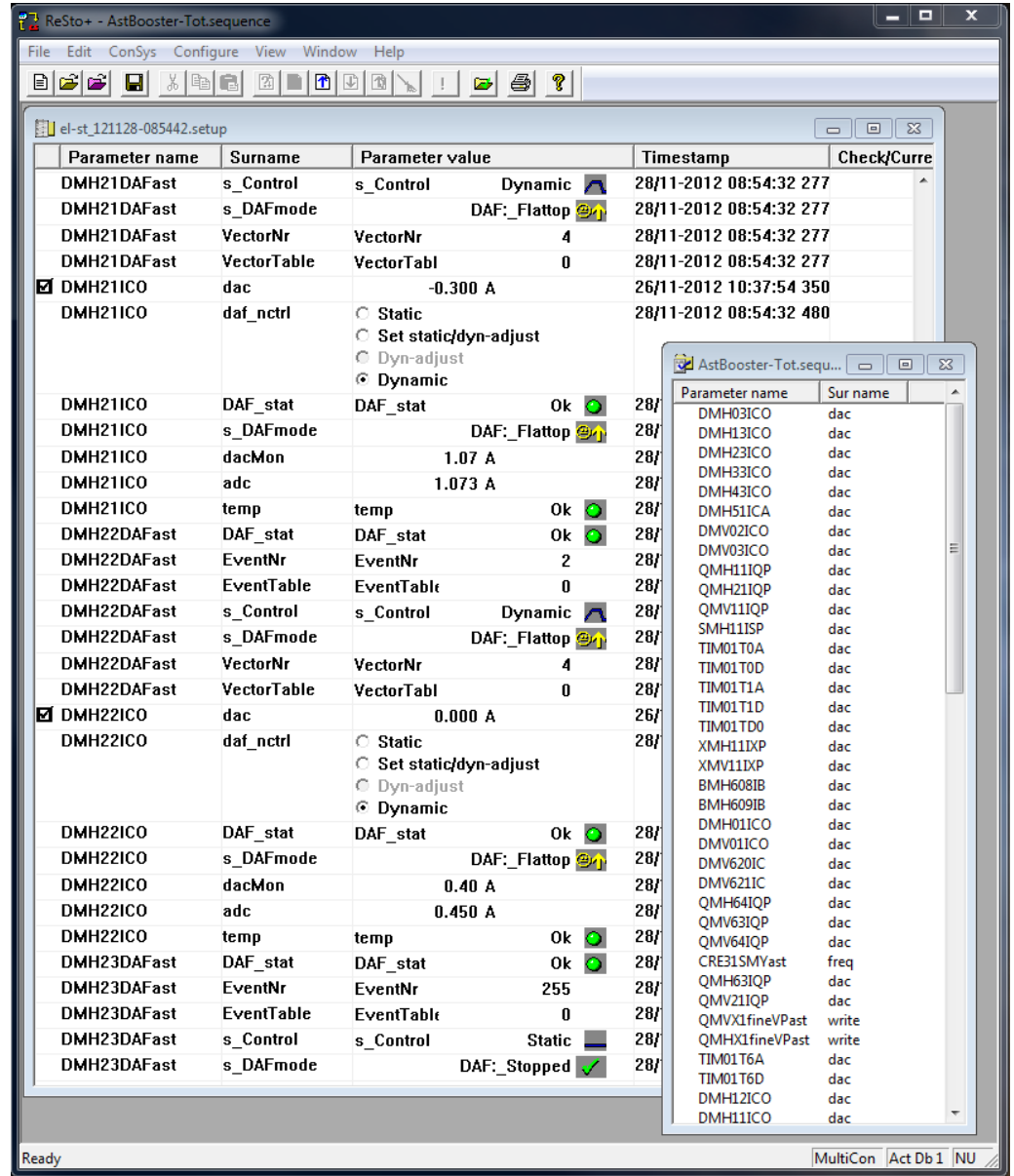
- > Selected parameters
- > Based on sequence files

> Compare

- > Current value with stored value

> Periodic

- > Store all
- > Retrieve values from several files



The screenshot shows the ReSto software interface. The main window displays a table of parameters with columns for Parameter name, Surname, Parameter value, Timestamp, and Check/Curre. A secondary window titled 'AstBooster-Tot.sequ...' provides a detailed view of a selected parameter, showing its Surname, Parameter name, and various control options like Static, Set static/dyn-adjust, Dyn-adjust, and Dynamic.

Parameter name	Surname	Parameter value	Timestamp	Check/Curre
DMH21DAFast	s_Control	s_Control Dynamic	28/11-2012 08:54:32	277
DMH21DAFast	s_DAFmode	DAF_Flattop	28/11-2012 08:54:32	277
DMH21DAFast	VectorNr	VectorNr 4	28/11-2012 08:54:32	277
DMH21DAFast	VectorTable	VectorTabl 0	28/11-2012 08:54:32	277
<input checked="" type="checkbox"/> DMH21ICO	dac	-0.300 A	26/11-2012 10:37:54	350
DMH21ICO	daf_nctrl	<input type="radio"/> Static <input type="radio"/> Set static/dyn-adjust <input type="radio"/> Dyn-adjust <input checked="" type="radio"/> Dynamic	28/11-2012 08:54:32	480
DMH21ICO	DAF_stat	DAF_stat Ok	28/	
DMH21ICO	s_DAFmode	DAF_Flattop	28/	
DMH21ICO	dacMon	1.07 A	28/	
DMH21ICO	adc	1.073 A	28/	
DMH21ICO	temp	temp Ok	28/	
DMH22DAFast	DAF_stat	DAF_stat Ok	28/	
DMH22DAFast	EventNr	EventNr 2	28/	
DMH22DAFast	EventTable	EventTabl 0	28/	
DMH22DAFast	s_Control	s_Control Dynamic	28/	
DMH22DAFast	s_DAFmode	DAF_Flattop	28/	
DMH22DAFast	VectorNr	VectorNr 4	28/	
DMH22DAFast	VectorTable	VectorTabl 0	28/	
<input checked="" type="checkbox"/> DMH22ICO	dac	0.000 A	26/	
DMH22ICO	daf_nctrl	<input type="radio"/> Static <input type="radio"/> Set static/dyn-adjust <input type="radio"/> Dyn-adjust <input checked="" type="radio"/> Dynamic	28/	
DMH22ICO	DAF_stat	DAF_stat Ok	28/	
DMH22ICO	s_DAFmode	DAF_Flattop	28/	
DMH22ICO	dacMon	0.40 A	28/	
DMH22ICO	adc	0.450 A	28/	
DMH22ICO	temp	temp Ok	28/	
DMH23DAFast	DAF_stat	DAF_stat Ok	28/	
DMH23DAFast	EventNr	EventNr 255	28/	
DMH23DAFast	EventTable	EventTabl 0	28/	
DMH23DAFast	s_Control	s_Control Static	28/	
DMH23DAFast	s_DAFmode	DAF_Stopped	28/	

DATABASEEDITOR

- > Configuration of ConSys DB
- > Tree structure:
 - > Machine Groups
 - > Clusters
 - > Parameters
 - > General DB tables
 - > Fields like a0..aN
 - > Type specific editing
 - > Named general fields
 - > Only used fields active

ConSysThrust 1 - DatabaseEditor

File View Options Tools Help

Parameter:
Param. name: BMH100IPSast2.lw
Description: Bending magnet
Param. id: 46237
Group: Astrid2
Access: write
Data type: floating point
Cns position: 1
Device: 1807 - BMH100IPS
(CDFMagnetSupply8000Device)
Frontend: 315 - WFEC09
LoaderInstance: 0

Database changes:
All database changes is written to:
* SQL database, dbChange table
* If 'Database' is set in ConSys Log filter
- to 'DatabaseEditor.txt'

Id	sur name	update ti...	posit...	access	inter...	a0	a1	a2	a3	a4	a5	a6	a7	a8
46237	lw	0	1	W		886	6							
46235	lr	0	2	R										
46220	Ur	0	3	R										
46240	Main	1000	4	R										
46213	PowerOn	1000	4	W										
46247	PowerOff	1000	5	W										

Parameter

Name: BMH100IPSast2
Sur name: lw
Update Min. Time: 0
Console position: 1
Device: 1807 - FE09: BMH100IPS (

Interpretation
Type: Unipolar Floating point, fixed field
Data Type: Floating point
Conversion Type: Unipolar
Display Type: Fixed format, t

Interpretation 886 : 0-400 A, BM

Interpretation
Type: Unipolar Floating po

Id	Description	mm	160.000	0.000	0.000	5.000	0.200	2.440e...
829	IFA Supplies Runt...							
830	Motor current							
831	Motor max velocity							
833	Motor resistance							
834	Motor Inductance							
836	AC Voltage							
837	AC current							
838	Leak current							
845	Wiggler encoder							
867	Camera Exp time							
875	VIN bypass counter							
881	Writes/Second							
884	0-100 A, BMV 211							
885	0-156 A, DF3100 Read back							
886	0-400 A, BMH100							

Interpretation Editor

Id: 886 Description: 0-400 A, BMH100

Interpretation type: 10: Unipolar Floating point, fixed field

Data Server: CFloatDataServer

Integers
0:Normal, 1:Sur name (I0) 1 0.0:1% 1:1% 2:10% (I8) 2
Width, high (I1) 8 (I9) 9
Decimals, high (I2) 3 (I10) 10
Width, normal (I3) 7 (I11) 11
Decimals, normal (I4) 3 (I12) 12
History mode, read (I5) 1 (I13) 13
History mode, write (I6) 100 (I14) 14
No dac bits (I7) 16 (I15) 15

Floating points
Max (D0) 400.0000000 History Mark Step (D4) 1.0000000
Offset (D1) 0.0000000 (D5) 5
Lower limit (D2) 0.0000000 Min. Step (LSB) (D6) 1.0000000e-003
Upper limit (D3) 399.9999929 (D7) 7

Text
Unit (T0) A
(T1)
(T2)

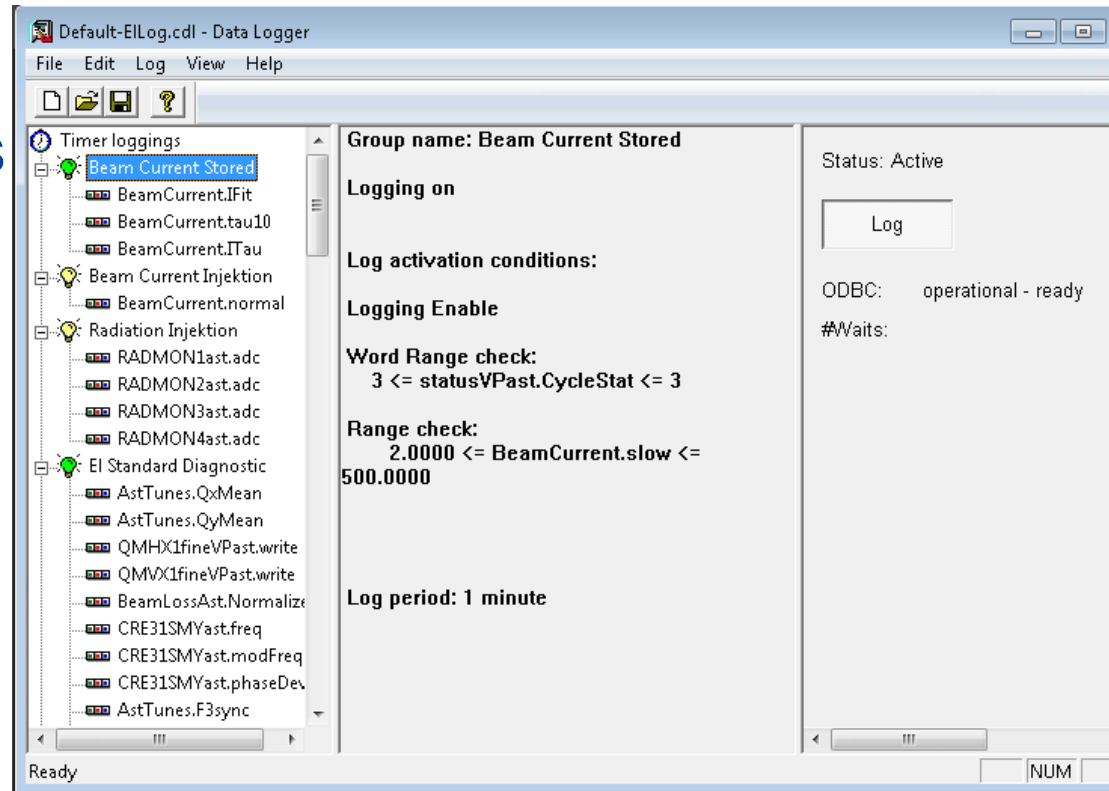
Enable all fields

OK Cancel

New Edit Copy Delete References OK Cancel

DATALOGGER

- › Log selected parameters to a SQL database.
- › Logging groups
 - › Parameters in groups
 - › Common log conditions
 - › Fixed intervals
- › Retrieval
 - › Web application
 - › CSPlot



CSPLOT

- › General plot program
 - › Plot any parameter
 - › Unlimited #parameters
- › Histories
 - › From devices at start-up
 - › Parameter history stored in RAM by devices.
 - › Typically 2 weeks of data stored
 - › Longer histories
 - › Retrieve SQL data logged by DataLogger



